Model 330 & 331
Hydrogen Sulfide Analyzers

Operator's Manual

Last Updated: May 6, 2014
Revision: 3

Envent Engineering Ltd. 7060 Bay E Farrell Road S.E. Calgary, Alberta, Canada,

T2H 0T2, Tel: 403.253.4012 | Fax: 403.253.4016

Email: info@envent-eng.com, Web: www.envent-eng.com

For further information, or a copy of our most recent operating manual, please visit us at www.envent-eng.com. Envent Engineering Ltd. reserves the right to change product design and specifications at any time without prior notice.

All products carry a one year limited warranty from the date of start-up or 18 months from date of shipment, whichever occurs first, F.O.B. the factory, against defective parts or workmanship.

TABLE OF CONTENTS

A. Figures and Tables 2
A.1. Figures 2
A.2. Tables 2
B. Introduction 3
B.1. Warnings and Cautions 4
B.2. Technical Specifications 5
C. Principle of Operation 6
C.1. Eductor Vent Assembly 8
C.2. Operator Interface 8
Computer Software 10
D. Installation and Start-up 11
D.1. Sample Point Selection 11
D.2. Sample Volume and Flow Rate 11
D.2.1. Sample Lag Time vs. Tubing Size 11
D.3. Sample Conditioning 12
D.4. Installation Procedure 13
E. Customer Connections 14
E.1. Relay Outputs and Solenoid Drivers 15
E.2. Analog Outputs 16
E.2.1. Optional Powered AO Board for Loop Power 17
F. Calibration 18
F.1. Calibration & Alarms 18
F.2. Calibration Procedure 18
F.2.1. Re-Zero Sensor Procedure 19
F.2.2. Tape Change Procedure 20
G. Maintenance & Troubleshooting 21
G.1. Monthly Checkup 21
G.2. Troubleshooting 21
G.3. Sample Conditioning System Cleaning Procedure 22
APPENDICES 24
Modbus Registry 24
Recommended Spare Parts List 25
H2S Concentration Conversion Factors 25
Sub-Assemblies 26
Standard System Drawings 27
Recommended Venting 28
Controller Board Schematic 30
Chico A Sealing Compound 31
Optional Low Pressure Switch 32

A. Figures and Tables

A.1. Figures

Figure 1: 330 & 331 Analyzer Principle of Operation Diagram 6
Figure 2: Sample Chamber and Parts 7
Figure 3: Eductor Block Information Diagram 8
Figure 4: 330-Standard Operator Interface (similar to 331) 9
Figure 5: 331 RS-232 Communication Connection 10
Figure 6: 330 DIN Receptable Communication Connection 10
Figure 7: 331&330 Flow Diagram 12
Figure 8: Controller Board Layout & Power Input 14
Figure 9: Relay Outputs and Solenoid Drivers 15
Figure 10: (4-20 mA) Output Wiring Options 16
Figure 11: Powered 4-20 mA Option 17
Figure 12: 331 Tape Change Procedure (similar to 330) 20
Figure 13: 330 Motor Box Assembly (exploded) 26
Figure 14: Sensor Chamber Assembly (exploded) 26
Figure 15: 331 Standard System Drawing 27
Figure 16: 330 Standard System Drawing 27
Figure 17: 330 Recommended Venting 28
Figure 18: 331 Recommended Venting 29
Figure 19: Controller Board Schematic 30
Figure 20: Chico A Sealing Compound 31
Figure 21: Optional Low Pressure Switch 32

A.2. Tables

Table 1: Technical Specifications 5
Table 2: Range & Aperture Information 7
Table 3: Analyzer Display-Button Functions 9
Table 4: Sample Lag Time vs. Tubing Size 11
Table 5: Customer Connection Summary 14
Table 6: Troubleshooting Recommendations 21
Table 7: Default Modbus Registry List 24
Table 8: Recommended Spare Parts List for 2 Years 25
Table 9: H2S Concentration Conversion Factors 25

B. Introduction

The Envent Engineering Ltd. model 330 & 331 hydrogen sulfide analyzers can be configured via software and hardware to measure a wide range of hydrogen sulfide concentrations in gases as well as in liquids.

With the addition of a hydrogen reaction furnace, the analyzer is also capable of total sulfur measurement. This manual describes the operation of the hydrogen sulfide analyzer. Additional sections will describe the operation of any optional equipment.

This manual contains a comprehensive overview of Envent Engineering's 330 & 331 H2S analyzer and step-by-step instructions on:

- Installation and Start-up
- Operation
- Maintenance
- Troubleshooting

This manual should be read and referenced by the person who will install, operate, or have contact with the 330 and/or 331. Take time to familiarize yourself with the content of this Operator's Manual, reading each section carefully so you can quickly and easily install and operate the analyzer.

The manual includes images, tables and charts that provide a visual understanding of the analyzer and its functions. Take note of all the caution symbols and notes, as they will alert you of potential hazards and important information.

B.1. Warnings and Cautions

CAUTION: The analyzer should be mounted in an area in which it is not exposed to vibration, excessive pressure, temperature and/or environmental variations.

CAUTION: Ensure that the analyzer received is suitable for the electrical classification of the installation site.

- *The 330 is designed for Class I Division 1 Groups B, C&D*
- *The 331 is designed for Class I Division 2 Groups A,B,C&D*

CAUTION: Analyzer may utilize an optional CCS, Model 646 Series pressure switch located on the side of the electrical enclosure:

- *Dual Seal, MWP 500PSI*
- *Annunciation is Visible Leakage from the pressure adjustment cover (flow from this cover can indicate the possibility that a failed primary seal condition could exist in the pressure switch).*

CAUTION: 330 Seals Not Poured. Pour seals before energizing the circuit (see APPENDIX on page 32 for further details).

CAUTION: Disassembly of the pressure regulator and solenoids in the field is not advised. Consult the factory if the regulator or solenoid appears contaminated.

CAUTION: Before resuming line pressure, be sure that all port connections, sample sweep and sample conditioning system are securely installed.

CAUTION: All connections must be LEAKTIGHT to ensure the effectiveness of the analyzer as well as SAFETY. The user, through his own analysis and testing, is solely responsible for the product selection, safety and warning requirements for the application. If the equipment is used in a manner not specified by Envent Engineering Ltd., the protection provided by the equipment may be impaired.

CAUTION: Do not use solvents, brake cleaner, soaps or detergents.

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.

CAUTION: This unit may require a disconnect device rated 24 VDC and 5A max, must be protected by a circuit breaker rated 24 VDC and 5A max and it is to be installed in accordance with local electrical codes.

CAUTION: This unit may require a disconnect device rated 240 VAC and 5A max, must be protected by a circuit breaker rated 240 VAC and 5A max and it is to be installed in accordance with local electrical codes.

CAUTION: The eductor is required with model 331 in order to maintain electrical safety and certification in Division 2 Areas.

CAUTION: The glass window on the model 330 must remain installed in order to maintain area classification.

B.2. Technical Specifications

Table 1: Technical Specifications

Specifications		
Measurement method	ASTM D4084 - 07: Standard Test Method for Analysis of Hydrogen Sulfide in Gaseous Fuels (Lead Acetate Reaction Rate Method).	
Ambient Temperature	0-50 °C (standard) consult factory for other requirements, 0 to 90% humidity (non-condensing).	
Power	12-24 VDC @ less than 3W.	
	Or, 100-240 VAC 50/60 Hz, 5W, (500W when total sulfur option is included).	
Electrical Certification	330	Class I, Division 1 Groups B,C&D.
	331	Class I, Division 2 Groups A,B,C&D.
	Certified to CSA standards File# MC 235646.	
Output Ranges	Standard ranges are between 10-100 ppb and 0-100 ppm.	
Response time	20 seconds to 90% of step change.	
Accuracy	1.5% of reading.	
Display	2 x 16 character LCD with back lighting, menu is scrolled by internal button or magnetic wand (330).	
Outputs	Two 4-20mA outputs (loop power required), optional 4-20mA powered output boards are available.	
	Serial (1) RS-232 Modbus protocol (1) RS-485 Modbus protocol Two additional serial ports plus Ethernet as an option.	
	4 SPDT relays (120 VAC 5A maximum).	
	4 solid state solenoid drivers.	
Optional Equipment		
Total Sulfur Option	Total sulfur reaction furnace converts all sulfur compounds to hydrogen sulfide which allows the analyzer to measure total sulfur.	
Auto Calibration	Allows user to initiate a calibration based on time of day or manually.	
Stream Switching	Switches between two sample streams or between hydrogen sulfide and total sulfur measurement.	
Dilution	A permeable membrane dilution system allows the analyzer to measure ranges above 100 ppm.	
Liquid sampling	Liquid sample conditioning system to measure hydrogen sulfide in Liquids.	

C. Principle of Operation

Envent Engineering Ltd. models 330 & 331 use ASTM D4084 - 07: Standard Test Method for Analysis of Hydrogen Sulfide in Gaseous Fuels (Lead Acetate Reaction Rate Method). This method uses lead acetate impregnated paper, referred to by Envent Engineering Ltd. as 'H2S sensing tape".

The H2S sensing tape reacts when in contact with hydrogen sulfide by the relationship shown below. This reaction is visibly evident by a brown stain directly on the H2S sensing tape. Considering this reaction, the electronics built into the Models 330 & 331 have been programmed to measure the rate of darkening over time which, in turn, gives the hydrogen sulfide concentration.

$$H_2S + Pb(CH_3COO)_2 \xrightarrow{H_2O} PbS + 2CH_3COOH$$

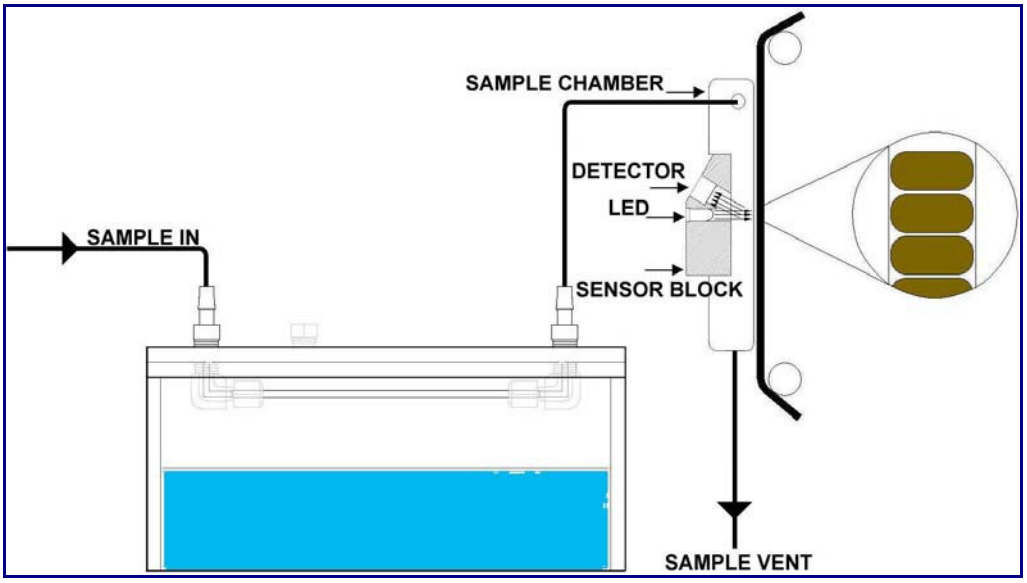


Figure 1: 330 & 331 Analyzer principle of operation diagram

The figure above shows a flow regulated, pressure regulated and filtered process sample gas passing through a membrane humidifier and into the sample chamber. A window in the sample chamber allows the gas to come in contact with the sensing tape creating the brown stain.

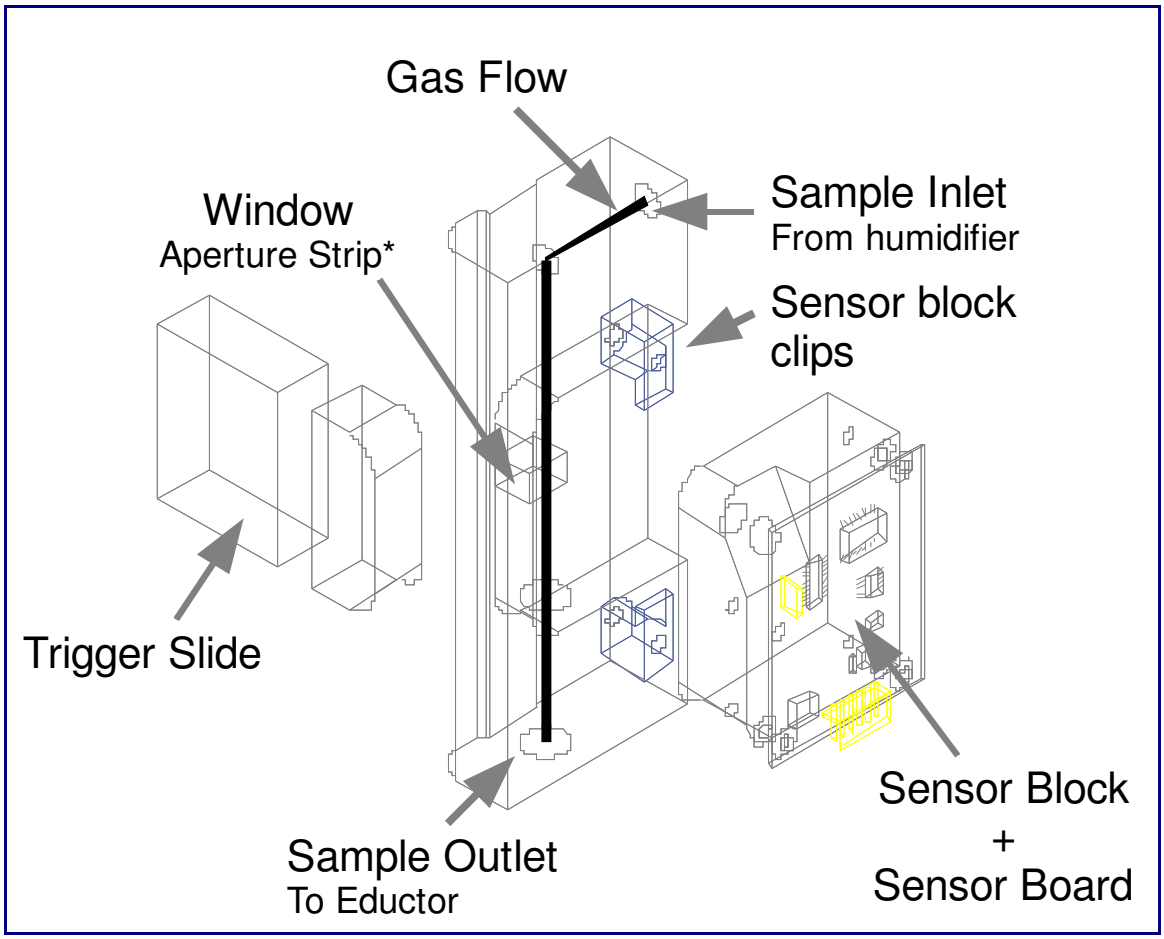


Figure 2: Sample chamber and parts

For concentration applications over 10 ppm there may be a restricting aperture behind the window. Various sizes of apertures match different measurement ranges. See the table below.

Table 2: Range & Aperture Information

Range	Aperture Size	PN
100 ppb – 10 ppm	None	NA
10 ppm – 20 ppm	1/16"	330103
20 ppm – 50 ppm	1/32"	330102
50 ppm – 100 ppm	1/64"	330101
More than 100 ppm	Consult Factory	

C.1. Eductor Vent Assembly

CAUTION: The eductor is required with model 331 in order to maintain electrical safety and certification in Division 2 Areas.

The analyzer reading can be affected by positive or negative pressure on the sample vent line. This can be caused by strong winds blowing across or directly into the vent; or by mechanical venting (exhaust fan). The eductor will eliminate any influence on the analyzer reading (optional for 330).

In cold climates, since the analyzer is venting a moist sample, freezing can occur. The eductor will help prevent freezing problems in the vent line due to the increased velocity and drying effect of the sweep gas. The eductor vent can also be retrofitted to existing analyzes.

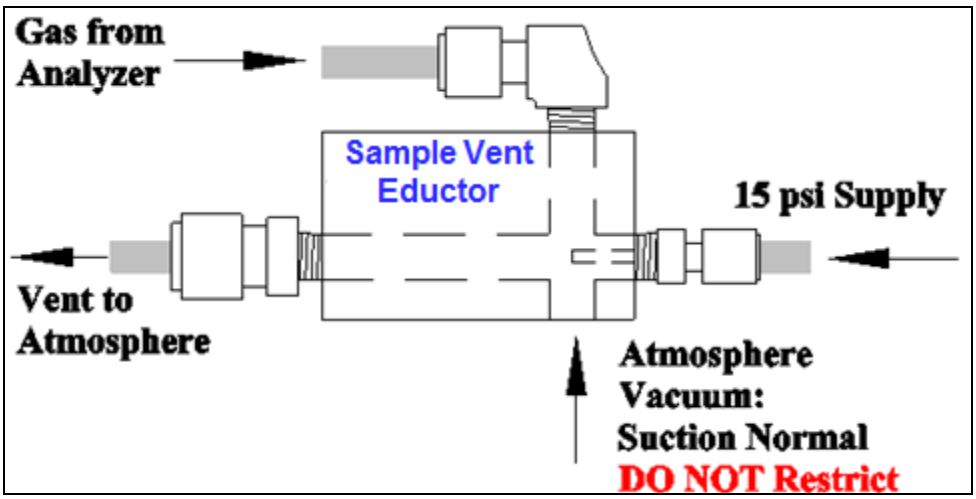


Figure 3: Eductor block information diagram

C.2. Operator Interface

The 330/331 Analyzer can be configured by using the display-button function or by connecting the analyzer to a computer through RS-232 or RS-485.

Note: The Envent Software for 330/331 is required to interface with the Analyzer. It can be downloaded from our website at: www.envent-eng.com

Display

By using the display on the Analyzer, the user can only view and/or change certain parameters set at the factory. The display is made up of a 2-line LCD and four push-buttons, the Top one used for Bypass, the Right and Left used to move the cursor and the bottom one to cycle though the display. Please refer to Table 3 for further details.

CAUTION: The glass window on the model 330 must remain installed in order to maintain area classification.

To configure the 330, use the magnetic wand from outside the enclosure window. If the area is non-hazardous, the window can be removed (if preferred) in order to press the internal buttons directly.

Figure 4: 330-standard operator interface (similar to 331)

Table 3: Analyzer display-button functions

Button	Description/Function
Bypass	Used to inhibit all analyzer alarms to a non-alarm state and sets the analog 4-20 mA output to 2 mA. The Bypass LED illuminates when Bypass mode is enabled.
Scroll Right [→]	Used to move the cursor to the right. Also used to SAVE configuration adjustments.
Scroll Left [←]	Used to move the cursor to the left. Also used to CANCEL configuration adjustments.
Menu/Set	Used to cycle through the menu options. Also used to increase numerical values when making configuration adjustments.

Computer Software

The software for the 330 & 331 allows the user to change the factory configuration. The software is available at the Envent website: www.envent-eng.com. Contact our technical support department for assistance. A separate software manual is included in the USB provided when purchasing the Analyzer.

In order to communicate with a 331 analyzer, plug into the RS-232 port located just above the mainboard.

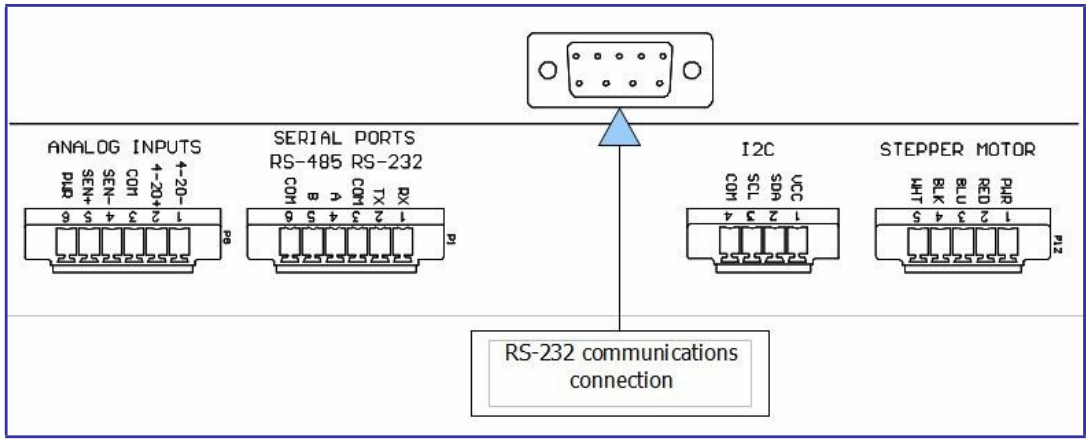


Figure 5: 331 RS-232 Communication connection

In order to communicate with a 330, plug into the DIN receptacle located just behind the window.

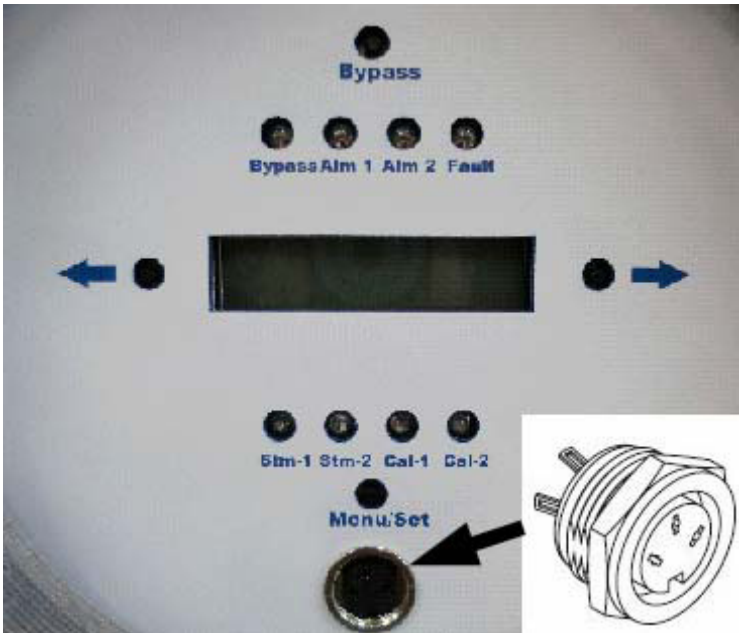


Figure 6: 330 DIN Receptable communication connection

D. Installation and Start-up

Your analyzer was configured, functionally tested and calibrated at the factory. All test and calibration data is documented in the factory calibration report (See the end of this manual).

CAUTION: The analyzer should be mounted in an area in which it is not exposed to vibration, excessive pressure, temperature and/or environmental variations.

Envent Engineering is available for installation and start-up, if required. See Envent's pre-commissioning guidelines on our website (http://www.envent-eng.com/documents.php).

D.1. Sample Point Selection

The sample to the analyzer must be representative of the process stream and should be taken from a point as close as possible to the analyzer to avoid lag times and sample degradation in the tubing. A probe must be installed vertically on a horizontal section of pipe ensuring that the sample is drawn from between the middle and the top third of the pipeline.

An optional Genie GPR probe regulator may be used. The function of this probe is to ensure a clean dry sample to the analyzer and to reduce the pressure of the sample. The lower pressure will improve the response time of the analyzer. For installation instructions, refer to associated documents. Do not install the Genie probe regulator on a vertical pipe.

D.2. Sample Volume and Flow Rate

The sample should be supplied to the analyzer at 10-15 psig and at a flow between 100-200 cc/min (set flowmeter at 2.0). A bypass sweep is recommended to reduce sample lag time in the sample line if it is at high pressure or it is longer than 15 feet. The standard sample tubing material is 1/4" 316 stainless steel; however, 1/8" stainless steel tubing can be used if the response time is critical (refer to table 4). Carbon steel sample line and/or fittings are not acceptable.

D.2.1. Sample Lag Time vs. Tubing Size

Table 4: Sample Lag Time vs. Tubing Size

Tube Size (")	Tube Gauge	ID (")	ID (cm)	Flow (SCFH)	Flow Std. (cc/min)	Pressure (PSIA)	Lag Time per 100' (min)	Lag Time per 100' (sec)
3/8	20	0.319	0.810	5	2359	800	36.30	2178
3/8	20	0.319	0.810	5	2359	200	9.07	544
3/8	20	0.319	0.810	5	2359	50	2.27	136
1/4	20	0.181	0.459	5	2359	800	11.69	701
1/4	20	0.181	0.459	5	2359	200	2.92	175
1/4	20	0.181	0.459	5	2359	50	0.73	44
1/8	20	0.081	0.205	5	2359	800	2.34	140
1/8	20	0.081	0.205	5	2359	200	0.59	35
1/8	20	0.081	0.205	5	2359	50	0.15	9

D.3. Sample Conditioning

The function of the optional sample conditioning system is to regulate and filter particulates or free liquids from the sample. Consideration must be taken from all potential conditions when designing the sample conditioning system. The figure below shows the typical sample conditioning system used for the 330 & 331.

NOTE: Sample conditioning systems that provide sample dilution, multiple stream switching, auto-calibration, liquid measurement capability and/or total sulfur measurement are available at customer request.

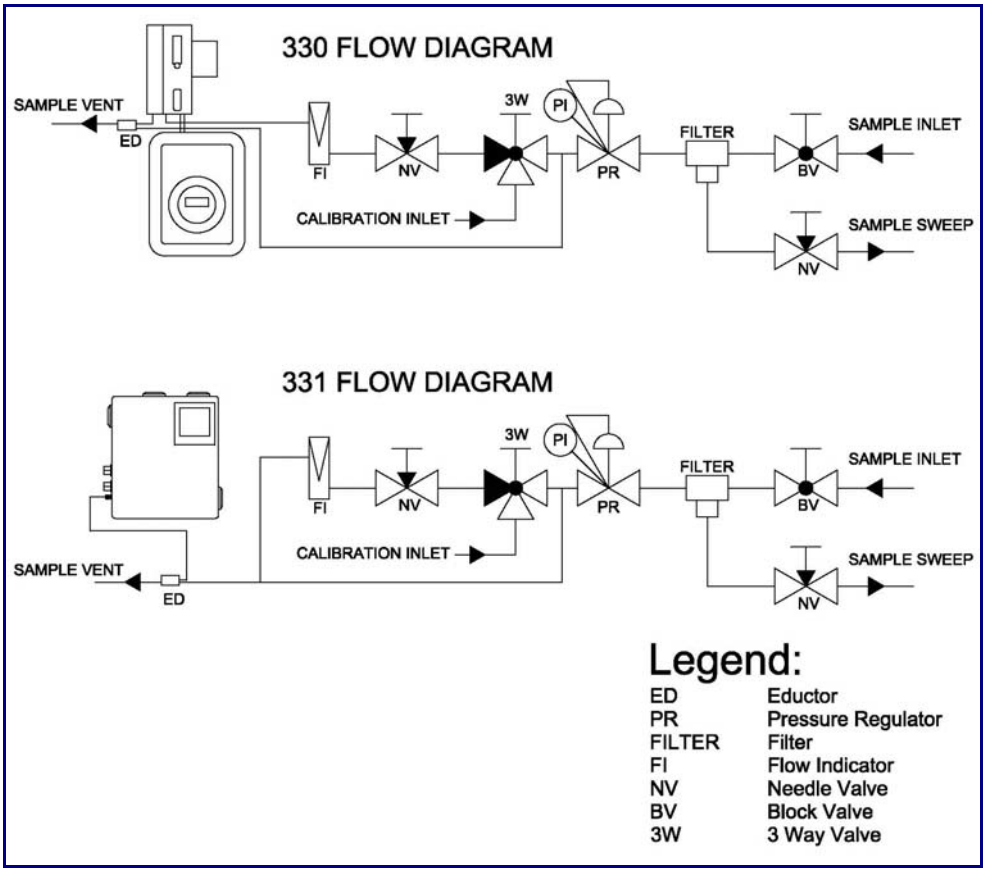


Figure 7: 331&330 Flow Diagram

The standard, coalescing & regulated sample conditioning system consists of a 5000 psig inlet filter and a 3000 psig inlet regulator. A three-way valve allows the user to switch from sample gas to calibration gas. The sample sweep valve on the filter is left slightly open to drain any liquids that may collect and to reduce lag time in the sample piping.

D.4. Installation Procedure

Step 1. Unpack the analyzer and check for damage.
Step 2. Ensure that the analyzer power supply and range are suitable for the application.
Step 3. Check that the hazardous location rating is suitable for the installation location.
Step 4. Select an installation location that is close to the sample point.

- Ensure that the selected installation site provides adequate room for maintenance and repair.

Step 5. Bolt the analyzer to the wall with the tape drive at approximately eye level.
Step 6. Wire power, analog outputs and discrete outputs to the analyzer.

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.
CAUTION: 330 Seals Not Poured. Pour seals before energizing the circuit (see APPENDIX on page 32).

Step 7. Tube the sample inlet, sample sweep and sample vent lines to the analyzer.

- 1/4" 316 stainless steel tubing is recommended for the sample tubing.
- 1/8" 316 stainless steel tubing can also be used if the response time of the analyzer is of particular concern.
- All fittings in the sample and vent lines must be 316 stainless steel.
- The vent line should be tubed with 3/8" stainless steel tubing to a maximum of 6 feet in length.
- 1/2" 316 stainless steel tubing should be used for vent lines exceeding 6'.
- The tubing should be installed with a slight downward slope and should be as short as possible.
- The sample vent line must be tubed to atmospheric pressure outside and cannot be connected to a flare line or heater.

Note: For recommended venting, see Appendix: Recommended Venting

Step 8. Ensure there is enough H2S sensing tape.
Step 9. Ensure there is enough 5% acetic acid, if the analyzer has a humidifier.
Step 10. With the sample pressure turned off (sample inlet valve closed).

- Apply power to the analyzer. The display will illuminate and the sensing tape will advance.
- Press the menu button until mV is displayed. Check that the mV reading is 1000 mV ± 100 mV.

CAUTION: Before resuming line pressure, be sure that all port connections, sample sweep and sample conditioning system are securely installed.

Step 11. Turn on sample gas flow (open sample inlet valve).
Step 12. Open the sweep valve slightly and adjust pressure regulator to 15 psig and the flowmeter to 2.0.

CAUTION: All connections must be LEAKTIGHT to insure the effectiveness of the analyzer as well as SAFETY. The user, through his own analysis and testing, is solely responsible for the product selection, safety and warning requirements for the application. If the equipment is used in a manner not specified by Envent Engineering Ltd., the protection provided by the equipment may be impaired.

Allow twenty minutes for the analyzer to stabilize. The analyzer calibration can be verified if calibration gas is available (refer to the calibration section). If no calibration gas is available, the analyzer may be operated using the factory calibration settings until calibration gas is available.

E. Customer Connections

CAUTION: This unit requires a disconnect device rated 24 VDC and 5A max, must be protected by a circuit breaker rated 24 VDC and 5A max and it is to be installed in accordance with local electrical codes.

CAUTION: Turn off power before servicing. Ensure breakers are off before connecting or disconnecting supply power.

All customer connections are indicated on the circuit board (refer to figure 6). For a larger view and detailed information on the controller board, please see Appendix: Controller Board Schematic. Note: if you have unreliable power, consider using a backup battery or an uninterrupted power source.

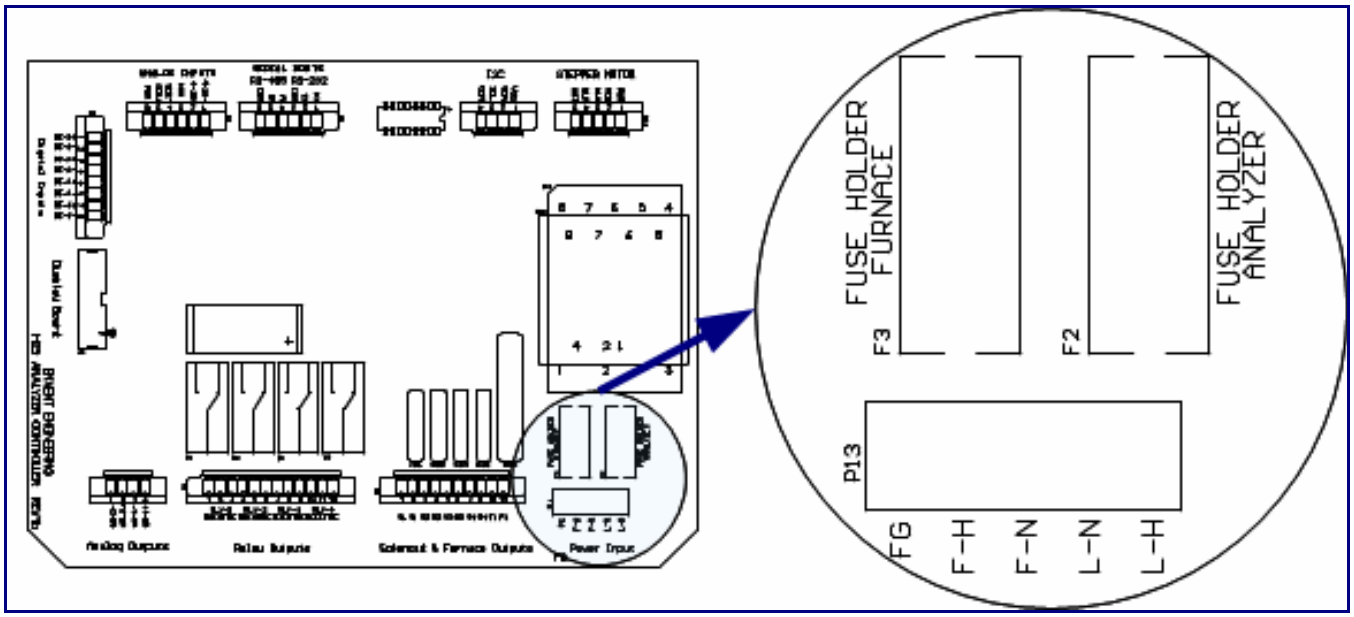


Figure 8: Controller Board Layout & Power Input

Note: Spare fuse, F3 included (if total sulfur not installed).

Table 5: Customer connection summary (see Figure above)

application	Positive	Negative/Neutral	Ground
AC	L-H hot	L-N neutral	FG
DC	L-H +	L-N -	NA

E.1. Relay Outputs and Solenoid Drivers

Four relays and four solenoid drivers are supplied on the 330/331 controller board. The relays are used as status outputs to drive external relays or solenoids. The solenoid drivers are used for external loads. DO NOT supply external power to solenoid drivers. The four solenoid drivers are provided to directly drive solenoids for shutdown, auto-calibration or stream switching.

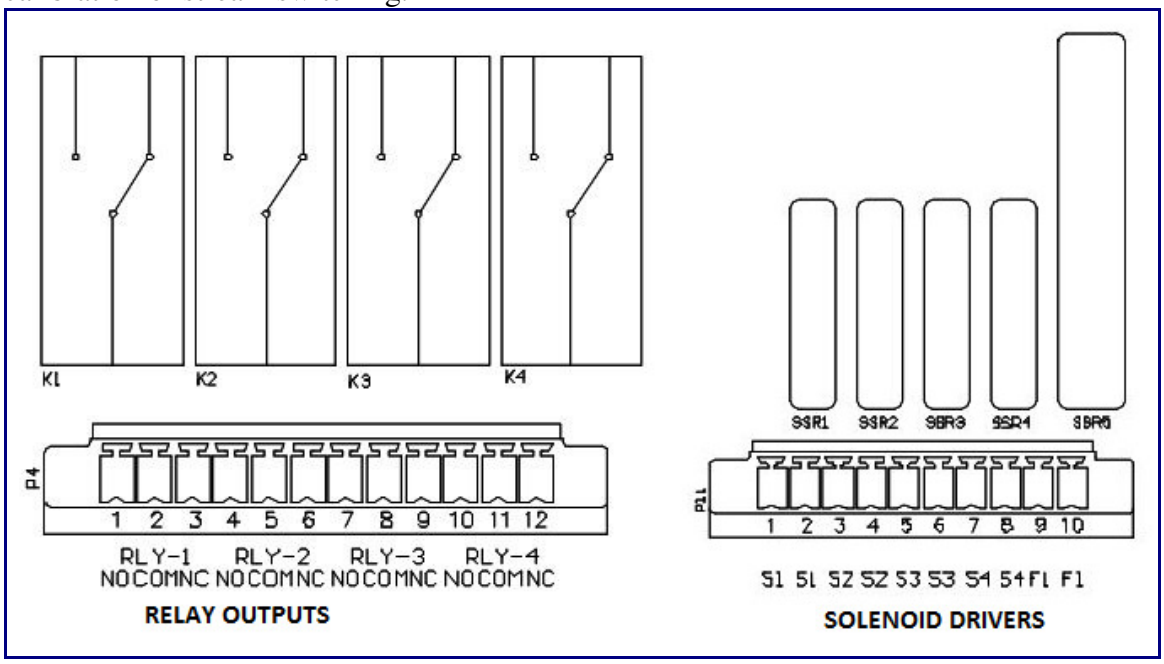
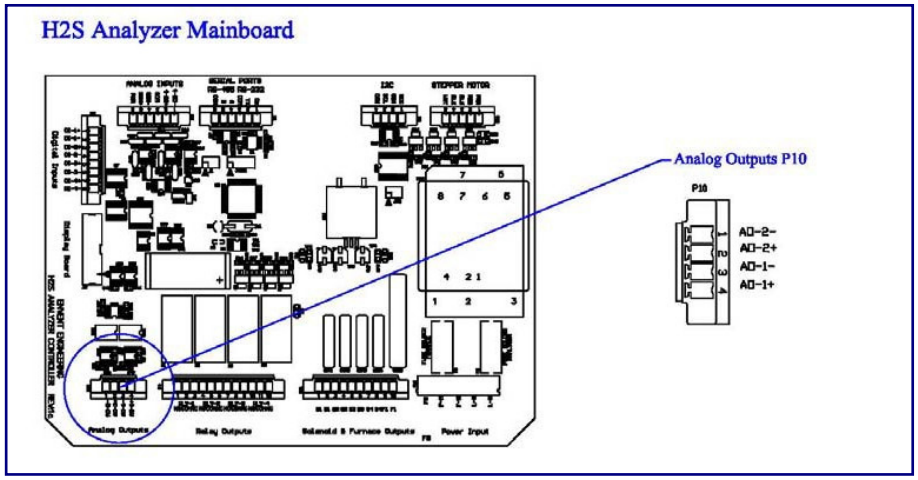

K1
K2
K3
K4
P4
1 2 3 4 5 6 7 8 9 10 11 12
RLY-1 RLY-2 RLY-3 RLY-4
NO COM NC NO COM NC NO COM NC NO COM NC
RELAY OUTPUTS
P11
1 2 3 4 5 6 7 8 9 10
S1 S1 S2 S2 S3 S3 S4 S4 F1 F1
SOLENOID DRIVERS

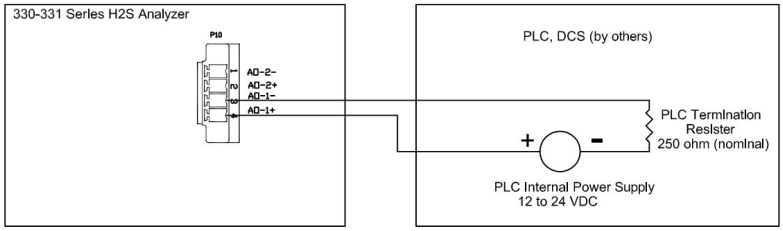
Figure 9: Relay outputs and solenoid drivers

E.2. Analog Outputs

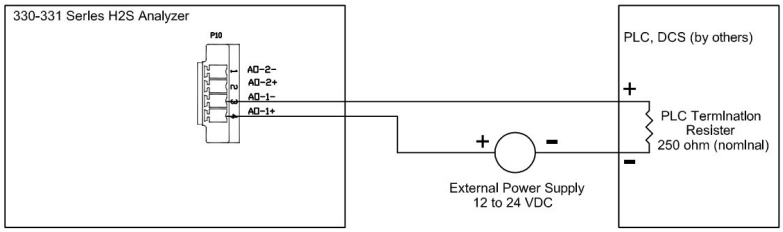
Two isolated analog outputs are provided. Both analog outputs are normally set to the full scale range of the analyzer. Loop power (10 to 32 volts) sourced from the end device (PLC) is required for the analog outputs. If it is not possible to provide loop power, optional powered AO boards are available.



PLC set for loop power (two wire transmitter)



PLC set for externally supplied loop power (three wire transmitter)



Envent powered AO option board

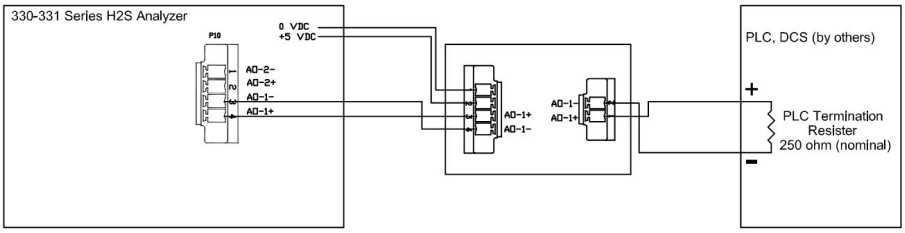


Figure 10: (4-20 mA) Output Wiring Options

E.2.1. Optional Powered AO Board for Loop Power

The Model 331 comes standard with 2 wire 4-20 ma output. An optional 4 wired powered 4-20 ma output is sometimes included. It is a small board located just below the analog output terminal on the main processor board.

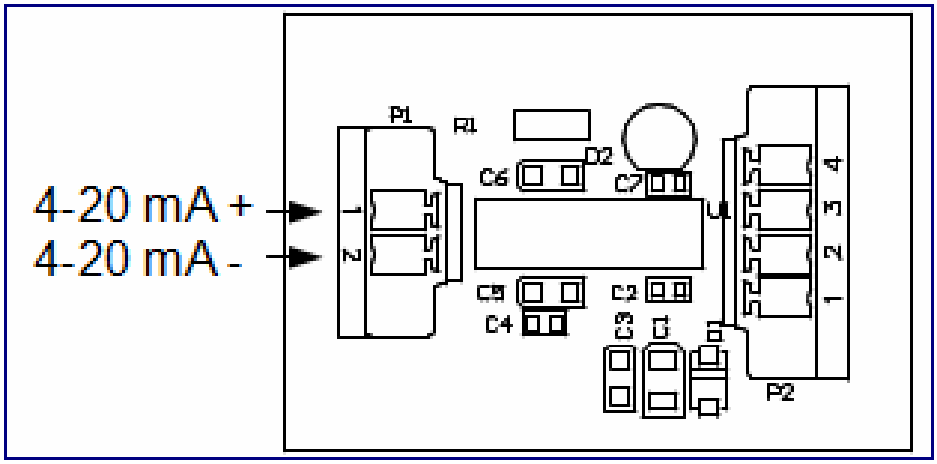


Figure 11: Powered 4-20 mA option

F. Calibration

F.1. Calibration & Alarms

Analyzer configuration and calibration was set at the factory. The factory gain and alarm settings can be found in the factory calibration sheet, found at the end of this manual. Analyzer settings can be read and adjusted using the operator interface display.

F.2. Calibration Procedure

1. Source a calibration gas of H2S in balance of N2 regulated to 15 psi (check expiry date). H2S concentration to be approximately 2/3 of full scale range or close to the H2S alarm set point.
2. Press the bypass button and verify the "Bypass" LED illuminates (alarms will be held in the non- alarm state).
3. Turn off all gas supplies to the analyzer and check that a sufficient amount of sensing tape is installed.
4. Press the "Menu/Set" button until "Mtr Run" is displayed. Press the right arrow [→], the H2S sensing tape will advance for approximately 10 seconds.
5. Press the "Menu/Set" button until "mV" is displayed ("###mV"). If the mV reading is 1000±100mV, proceed to the next step, otherwise re-zero sensor (Refer to section F.2.1 – Start at step 4).
6. Connect calibration gas to calibration port and turn 3 way calibration valve 180°. The valve handle should be pointing towards where the gas bottle tubing is connected to.
7. Turn on sample inlet valve, ensure that the sample regulator is supplying 15psig to the eductor (make sure there is suction from the eductor block). Adjust the flow meter to 2.0. Wait until the H2S reading has stabilized (10 to 15 minutes).
8. With calibration gas applied, if H2S reading is satisfactory (±2% of analyzer full range) skip to step 16, if H2S reading is not satisfactory a gain adjustment is required, continue to step 9.
9. Press the "Menu/Set" button until the gain setting is displayed ("### Gain").
10. Calculate the new gain. New gain value should be within approximately 25% of the gain installed at the factory.

$$\left[\frac{\textit{Cal Gas Concentration}}{\textit{Current Reading}}\right] \times \textit{(Current Gain)} = \textit{(New Gain)}$$

11. To adjust the gain setting such that the analyzer displays the correct H2S concentration, press the right [→] and / or left [←] arrows until the cursor is underneath the number you wish to change.
12. Adjust the number using the "Menu/Set" button (it will increase until "9" then will cycle back through "0").
13. Save the new gain value by pressing the right arrow [→] until "Saved "appears or discard by pressing the left [←] arrow until "Cancel" appears.
14. Allow the analyzer to complete two cycles using the new gain value. The H2S reading should match the calibration gas concentration. Repeat step 10 if necessary.
15. Return to sample gas flow using the 3 way calibration valve.
16. Set the sample gas pressure to 15 psig and set the flow meter to 2.0.
17. Disconnect the calibration gas supply.
18. After waiting 10 to 15 minutes confirm the analyzer reads below the H2S alarm set points.
19. Remove the analyzer from bypass mode by pressing the bypass button. Verify the "Bypass" LED turns off. Caution: alarms are armed.

F.2.1. Re-Zero Sensor Procedure

1. Press the bypass button and verify that the "Bypass" LED illuminates.
2. Turn off sample gas flow using sample inlet valve.
3. Press the "Menu/Set" button until "Mtr Run" is displayed. Press the right arrow [→], the H2S sensing tape will advance for approximately 10 seconds.
4. Remove the sensor cover.
5. Press the small pushbutton on the sensor block located on the lower left side next to the wire connector.
    - The sensor block will implement a "re-zero" procedure, indicated by a lit, red LED.
    - When the "re-zero" procedure is complete the LED light will turn green.
6. Initiate another motor run (Step 3).
7. Press the "Menu/Set" button until "### mV" is displayed.
    - Value should be between 900 & 1100 mV
8. Put on sensor cover.
9. Turn on sample gas flow using sample inlet valve.
10. Set the gas pressure to 15 psig and the flow meter to 2.0.
11. Confirm the analyzer reads below the H2S alarm set points.
12. Remove the analyzer from bypass mode by pressing the bypass button. Verify the "Bypass" LED turns off. Caution: alarms are armed.

F.2.2. Tape Change Procedure

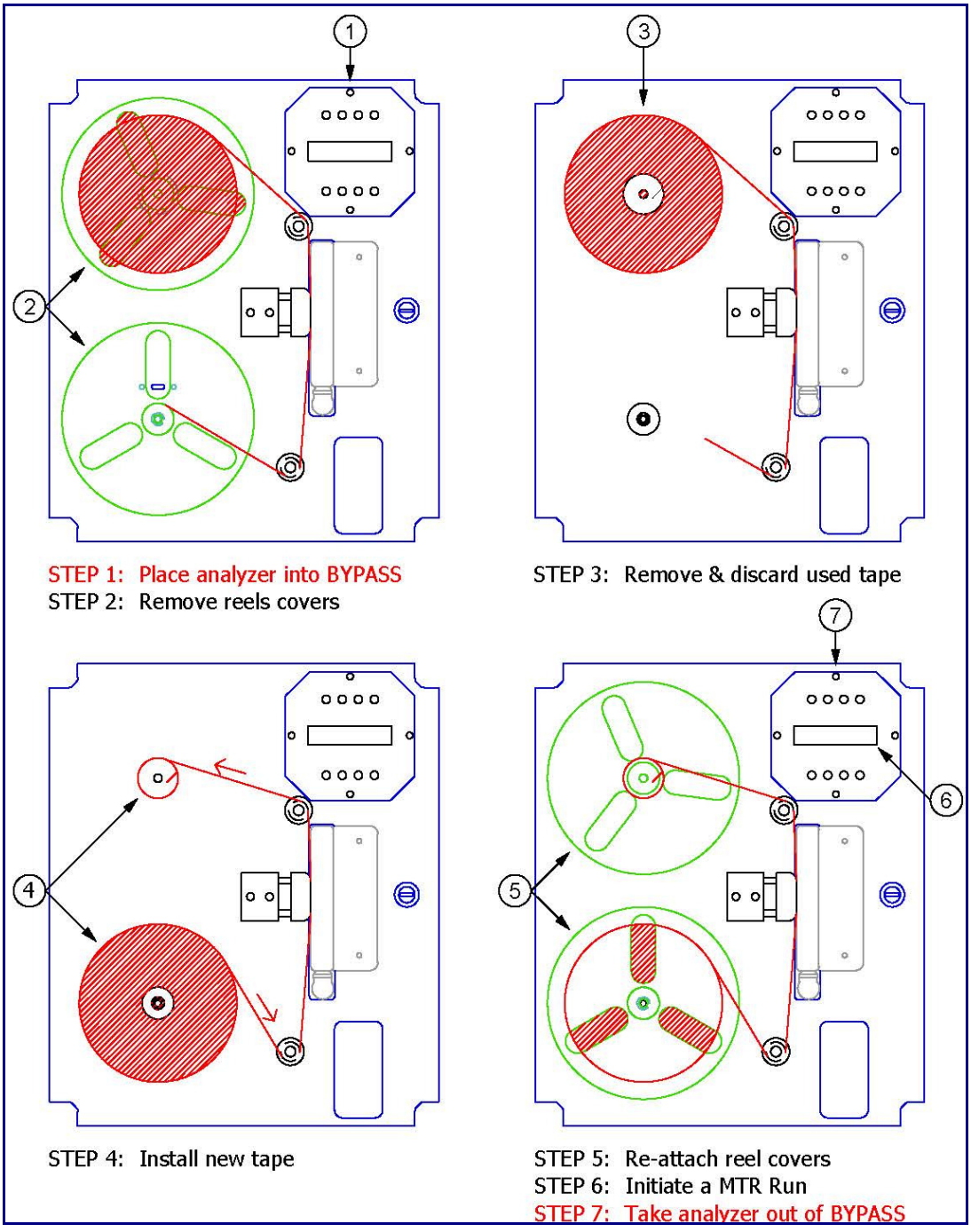


Figure 12: 331 Tape change procedure (similar to 330)

G. Maintenance & Troubleshooting

G.1. Monthly Checkup

Your analyzer will provide reliable service with very little attention. If the analyzer is kept clean there should be no requirement to recalibrate from factory gain settings. However, regular check-up will ensure that the analyzer is operating to specifications.

- Ensure that the tape take-up and feed reels are tight
- Ensure that the flow meters, humidifier tubing and sample chamber tubing are free of liquid or particulate contamination.
- Check that the sample conditioning filters every tape change or when sample conditioning system is saturated with liquid. Replace the inlet filter as required.

G.2. Troubleshooting

For other possible solutions, please visit the 'Frequently Asked Questions' section of our website, at www.envent-eng.com/H2SFAQ.php.

Table 6: Troubleshooting recommendations

Problem	Possible reasons	Possible Solution
Erratic H_2S Readings	a. Trigger slide not seated properly	Ensure trigger slide is seated in the groove of the sample chamber.
	b. Pressure in building moving up and down from fan, exhaust or wind	Eductor may be plugged or vent blocked. Check that all vent tubing and fittings are 316 stainless steel, sized 3/8" or larger.
	c. Sample vent either blocked or frozen	Vent should be 3/8" or larger tubing on a downward slope. Possible heat trace required.
	d. Liquid carry over in sample conditioning system	Sample conditioning system requires cleaning. Refer to Cleaning procedures.
	e. Regulator not maintaining 15 psig	Pre-regulation to 50 psig of sample at sample point. Possible regulator requires repair or replacement of Hydrocarbon liquid carried over through the sample regulator. Heated regulator may be required.
	f. Analog Input 2 jumper removed	Re-install jumper in Analog Input across (+ 4-20 & -4-20).
	g. Sensor block fault	Re-zero Sensor block. Refer to Sensor Re-zero procedure. Check for green status led on sensor block.
	h. Contaminants in sample chamber	Clean sample chamber. Replace aperture and window if required.
		Clear grease from window. Envent no longer uses grease on the chamber window. *Applies to earlier H_2S analyzers.*
	i. Contaminants in sample conditioning system	Sample conditioning system requires cleaning. Refer to Cleaning procedures on page .
Tape does not advance	a. No tension on take up reel	Check setscrew in take up reel collars. Check to see if manual advance is possible on tape.

Continued on next page

Problem	Possible reasons	Possible Solution
Tape breaking	a. High liquid content in sample gas	Genie probe and additional filtration may be required.
	b. Feed wheel not spinning freely	Dust and refuse build up between feed wheel and chassis. Requires removal and cleaning of chassis.
	c. Tape cover wheels pressing against tape	Tape cover wheel became warped. Needs to be flattened to not contact tape when on feed wheel bolt.
	d. Trigger slide not seated properly	Ensure trigger slide is seated in groove of sample chamber.
Slow Response	a. Aperture in chamber not optimized for range	Removal or change of aperture type required. Contact Envent tech support for ideal setting.
	b. Liquid contamination in sample tubing	Sample conditioning system requires cleaning. Refer to Cleaning procedures.
	c. Sensor block in fault	Re-zero Sensor block. Refer to Sensor Re-zero procedure.
Higher or Lower than expecting reading	a. Liquid contamination in sample tubing	Sample conditioning system requires cleaning. Refer to Cleaning procedures.
	b. Sample vent either blocked or frozen	Vent should be 3/8" or larger 316 stainless steel tubing on a downward slope. Possible heat trace required.
	c. Contaminants in sample chamber	Sample conditioning system requires cleaning. Refer to cleaning procedures.
Fault light indicated	a. Sensor Low fault	Re-zero Sensor block. Refer to Sensor Re-zero procedure.
	b. Sensor High fault	Re-zero Sensor block. Refer to sensor re-zero procedure.
	c. Low Tape	Sensing tape requires change. Possible low tape sensor failure.
	d. Low Pressure	Pressure on outlet of regulator is lower than set point of pressure switch *(factory set to 10 psi)*.
Sensor Fault	a. Sensor didn't zero on white tape	Re-zero Sensor block. Refer to Sensor Re-zero procedure.
	b. Sensor Wire failure	Wire or Sensor requires replacement.

G.3. Sample Conditioning System Cleaning Procedure

CAUTION: Do not use solvents, brake cleaner, soaps or detergents.

During startup or plant upset situations, the hydrogen sulfide analyzer may become contaminated with amine or hydrogen sulfide scavenger solution. This may cause the analyzer to read low (this can be determined at calibration). If the analyzer reads low, it will require incremental increases in the gain to maintain calibration. Please refer to factory calibration sheet for factory set gain factor. The scavenger solution is water soluble and therefore is relatively easy to clean.

Material List

Cleaning kit part number: 330900

- Alconox Laboratory cleaner or equivalent residue free cleaning agent
  - **Do not use solvents, detergents or soaps!**
- Fresh water
- 100% Isopropyl Alcohol
  - **Do not use rubbing alcohol!**
  - **Do not use brake cleaner product!**
- Large bucket to mix cleaning solution
- Rinse bottle

Procedure

Step 1. Mix a 1% (2-1/2 tbsp per gallon) of Alconox in warm water

Step 2. Sample line tubing

- Shut off flow at the sample point prior to sample conditioning system
- Flush the sample line and components with cleaning solution
- Rinse with fresh water
- Flush with isopropyl alcohol
- Dry with clean, dry instrument air or gas

Step 3. Sample conditioning system

CAUTION: Disassembly of the pressure regulator and solenoids in the field is not advised. Consult the factory if the regulator or solenoid appears contaminated.

- Remove filter elements from filter housings and discard
- Remove all sample conditioning system components and soak in cleaning solution
- Ensure valves are fully open when cleaning
- Flush sample components with fresh water
- Rinse with isopropyl alcohol
- Blow dry with clean compressed air or fuel gas
- If the any clear (Tygon) tubing appears discolored, replace the tubing
- Tubing on humidifier should be replaced if it appears contaminated

Step 4. Re-assemble Stainless Steel Tubing to analyzer according to analyzer drawing (refer to back of manual).

Step 5. Once sample conditioning system has been re-assembled, apply calibration gas to the analyzer, refer to section E.2.

Step 6. Adjust gain to indicate value from calibration certificate.

Step 7. Gains for streams should be ± 2.00 from factory calibration sheet or last calibration.

- If the reading is not within range, then the analyzer sample conditioning system may need further cleaning. Please consult factory.

APPENDICES

Modbus Registry

Please note that due to differences in PLCs, these registries may be shifted by one value. Note that these can be modified if necessary.

Table 7: Default Modbus Registry list

Coils		MODICON 32-bit standard protocol	Enron Protocol
Discrete Output 1	Solenoid 1	0000	1001
Discrete Output 2	Solenoid 2	0001	1002
Discrete Output 3	Solenoid 3	0002	1003
Discrete Output 4	Solenoid 4	0003	1004
Discrete Output 5	Relay 1	0004	1005
Discrete Output 6	Relay 2	0005	1006
Discrete Output 7	Relay 3	0006	1007
Discrete Output 8	Relay 4	0007	1008
Virtual Output 1	DI-1 (Low Tape)	0008	1009
Virtual Output 2	Sensor Low	0009	1010
Virtual Output 3	Sensor High	0010	1011
Virtual Output 4	Low Temp	0011	1012
Floating Point		**MODICON 32-bit standard protocol**	**Enron Protocol**
Process Stream 1 (H_2S)		40001	7001
Process Stream 2 (H_2S)		40002	7002
Analog Input Current 1 (raw mV)		40003	7003
Analog Input Current 2 (CO_2 or °F)		40004	7004
RRA Current Value (H_2S)		40005	7005
Board Temperature (°C)		40006	7006

Recommended Spare Parts List

Table 8: Recommended spare parts list for 2 years

Part Number	Qty	Description
330063	1	humidifier rebuild kit c/w elbows, nafion tube, ftg
330079	4	Rear Window & Gasket
330103	2	Aperture Strip (Associated to measurement range)
330130	2	4 litre containers of Acetic Acid
330133	12	300' Lead Acetate Tape
330406	1	Box of 10 Micrafilter glass fibre element 12-57-50S
330423		13" chubby quartz tube (total sulfur option only)
330431		Kalrez o-rings (total sulfur option only)
330900	1	Tubing, cleaner, fittings maintenance kit
330424		Furnace Element (total sulfur option only)

H2S Concentration Conversion Factors

Table 9: H2S Concentration conversion factors

Original Unit	Multiply By	Final Unit
mg / m^3	0.698	ppm
ppm	0.0626	grain / 100 cf
%	10 000	ppm
Mole / kMole	1000	ppm

Sub-Assemblies

#	PART NUMBER	DESCRIPTION
1	330028	TAKE UP WHEEL
2	330030	FEED WHEEL SHAFT
3	330024	TAKE UP BEARING BLOCK
4	330029	COUPLING 1/4"
5	330082	EXPLOSION PROOF SHAFT ASSEMBLY
6	330116	MOTOR BOX
7	330020	MOTOR MOUNTING BRACKET XP
8	330031	COUPLING 3/16"
9	330021	12 V STEPPER MOTOR

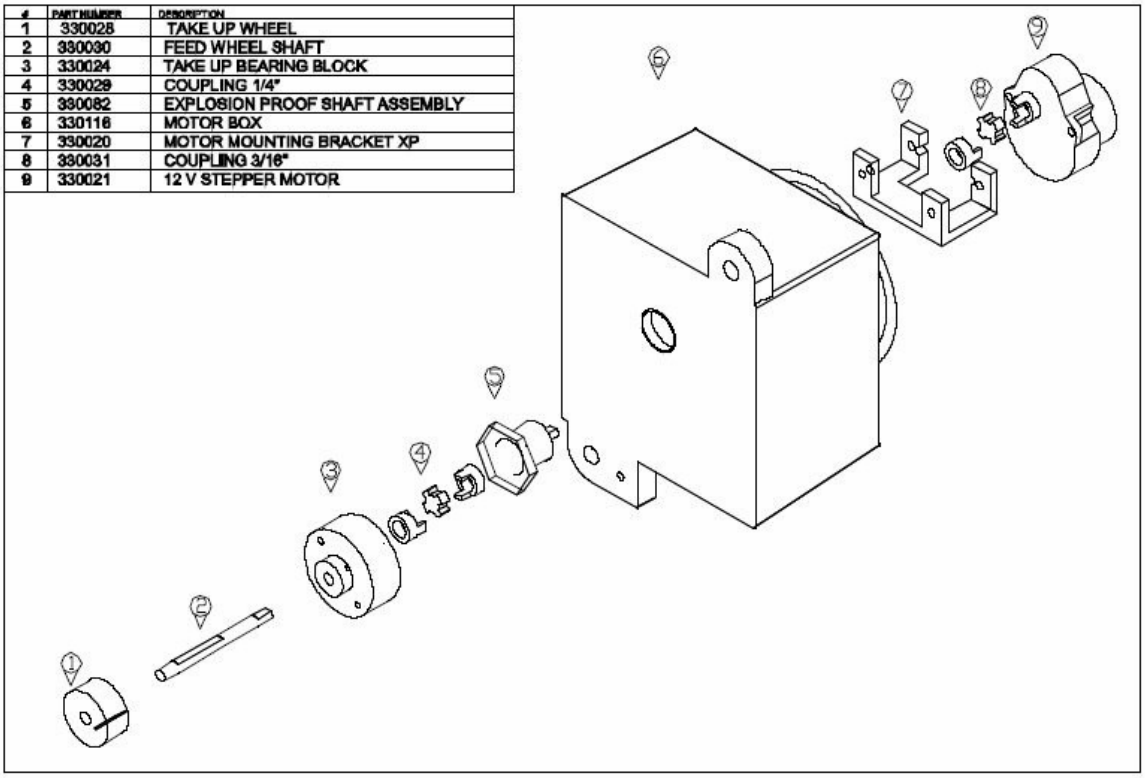


Figure 13: 330 Motor box assembly (exploded)

#	Description	Part number
1	Trigger Slide	330042
2	Sample Chamber	330075
3	Senosr block clips	330074
4	Sensor block	330230

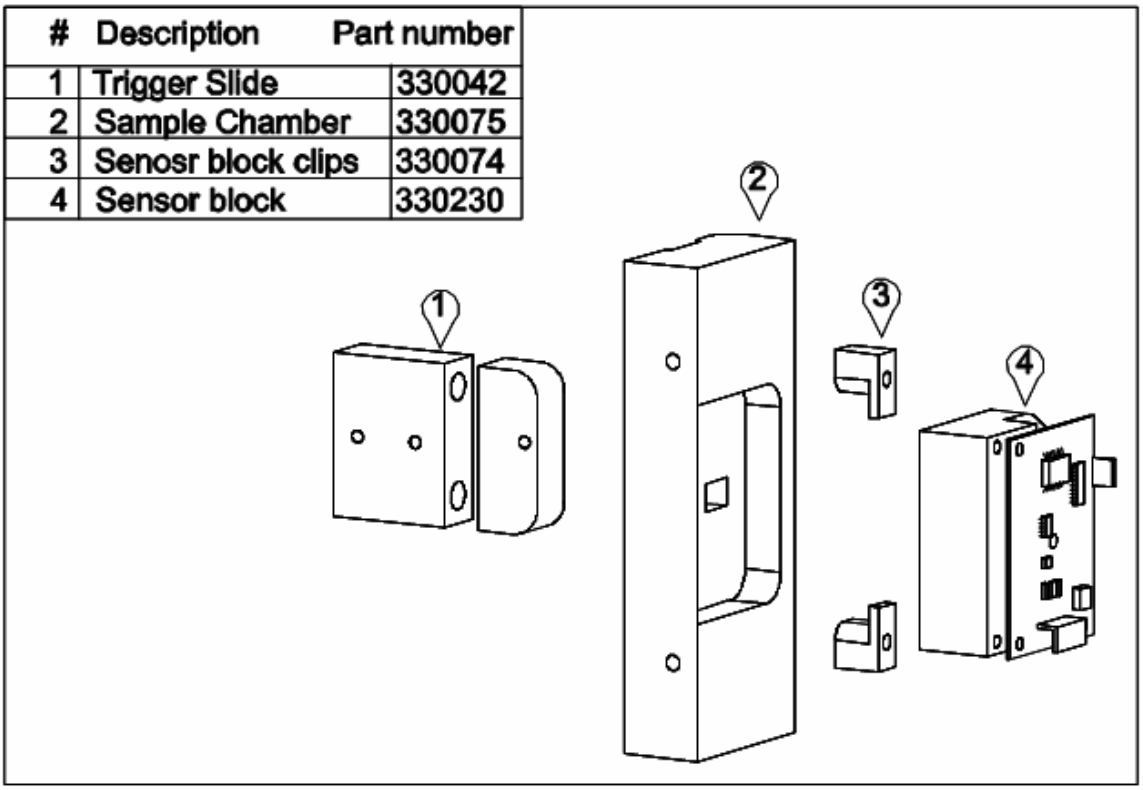


Figure 14: Sensor chamber assembly (exploded)

Standard System Drawings

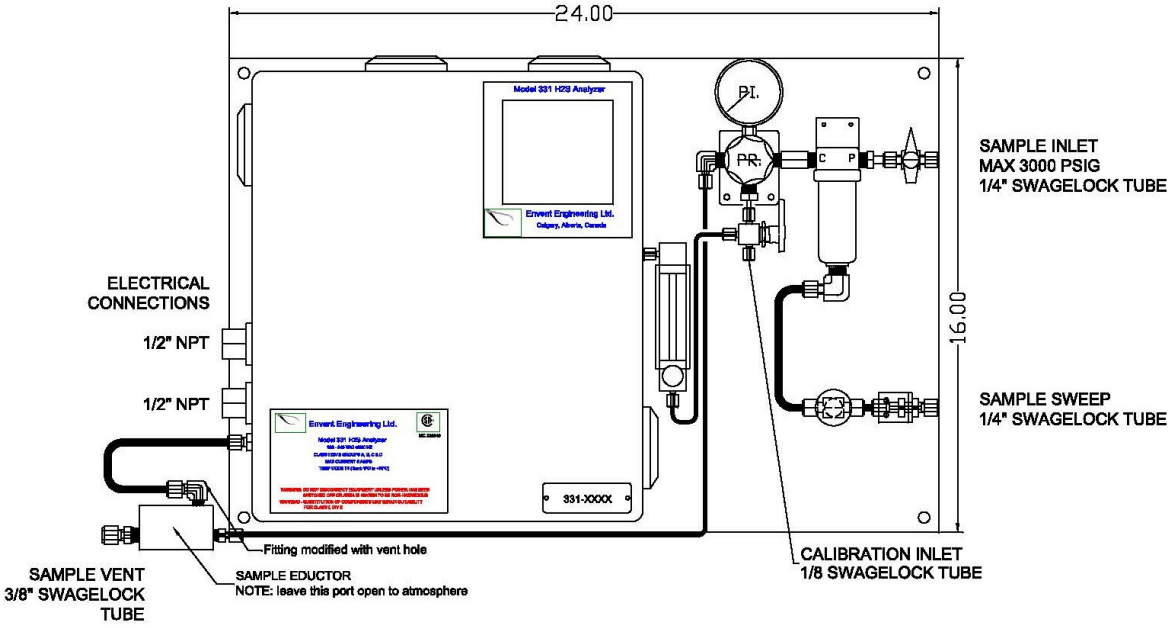


Figure 15: 331 Standard system drawing

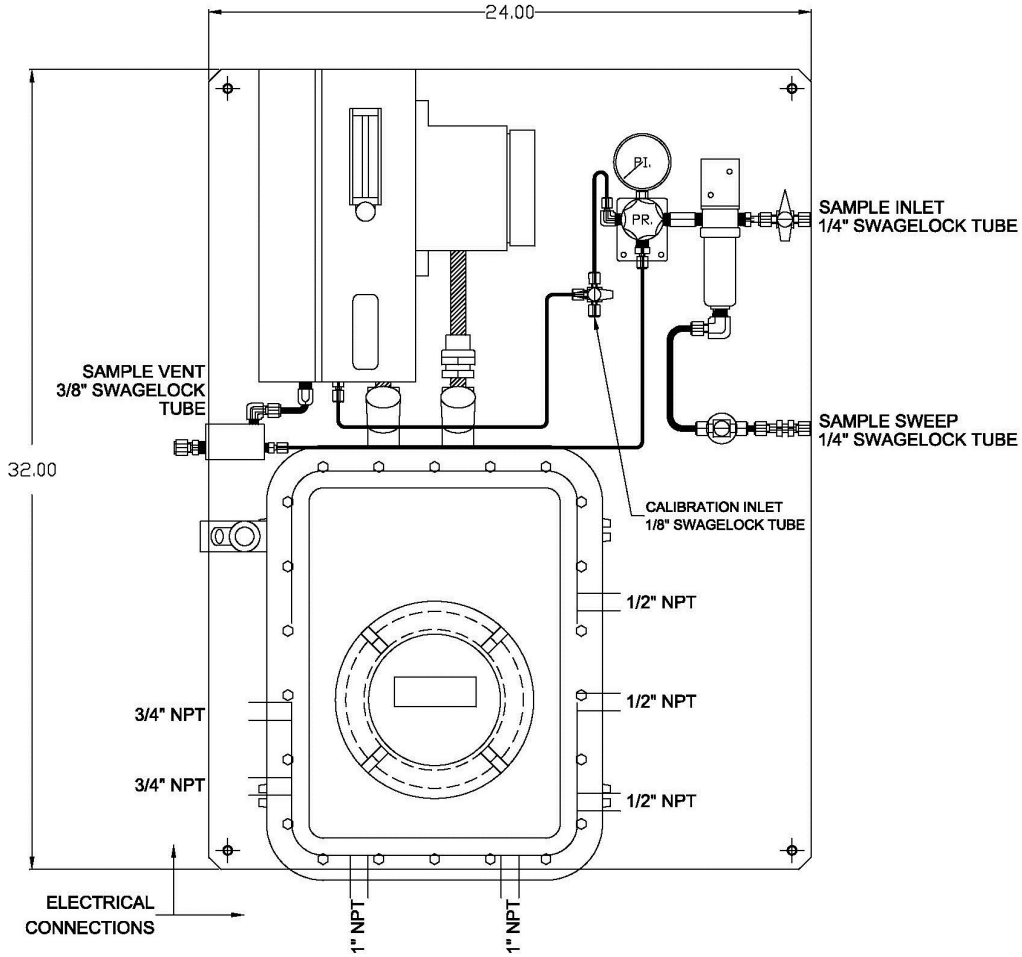


Figure 16: 330 Standard system drawing

Recommended Venting

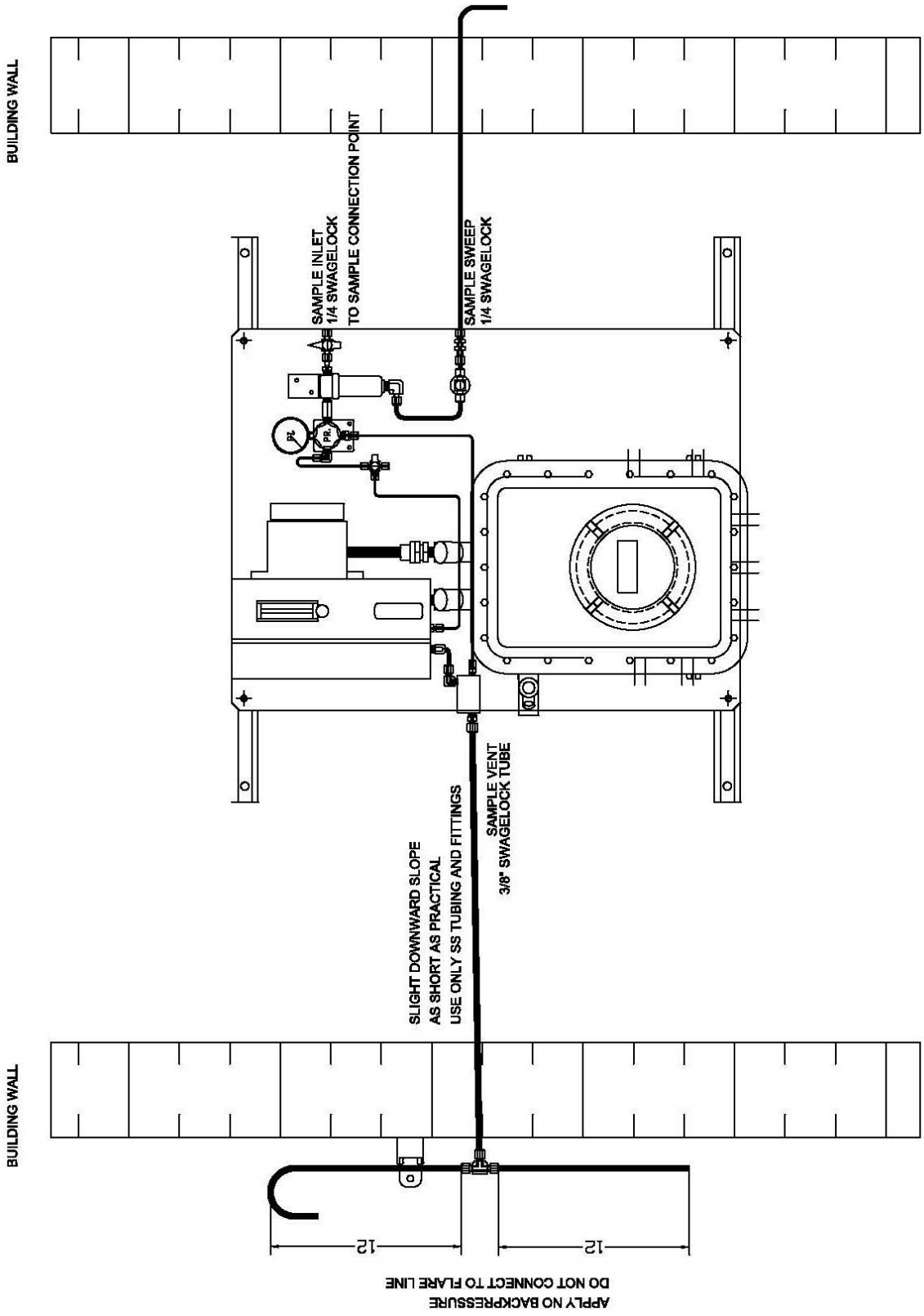


Figure 17: 330 Recommended venting

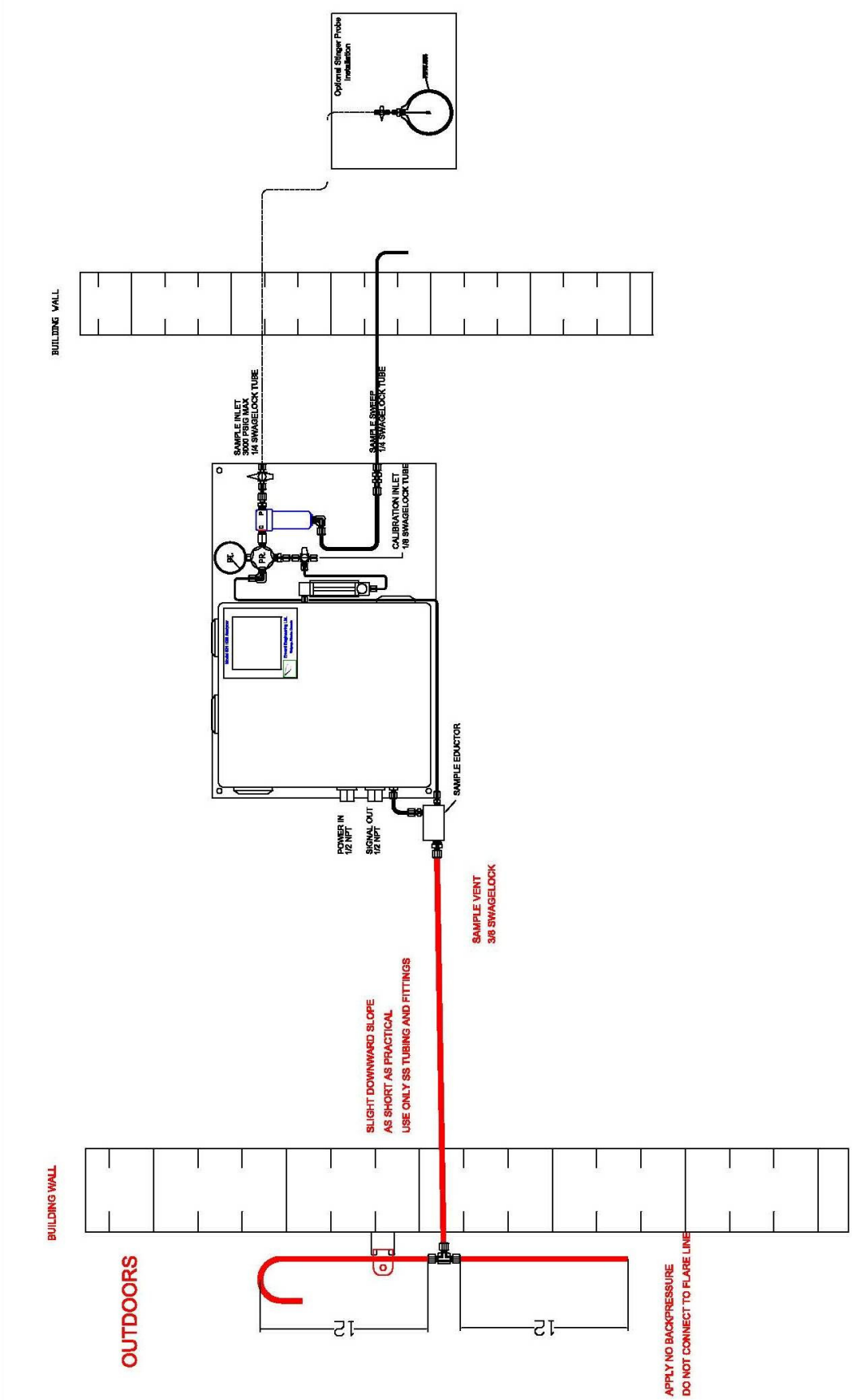


Figure 18: 331 Recommended venting

Controller Board Schematic

The controller board (mainboard) is used in both the 331 and 330 models. Note that the power supply shown here is for DC applications, but directly applies to AC.

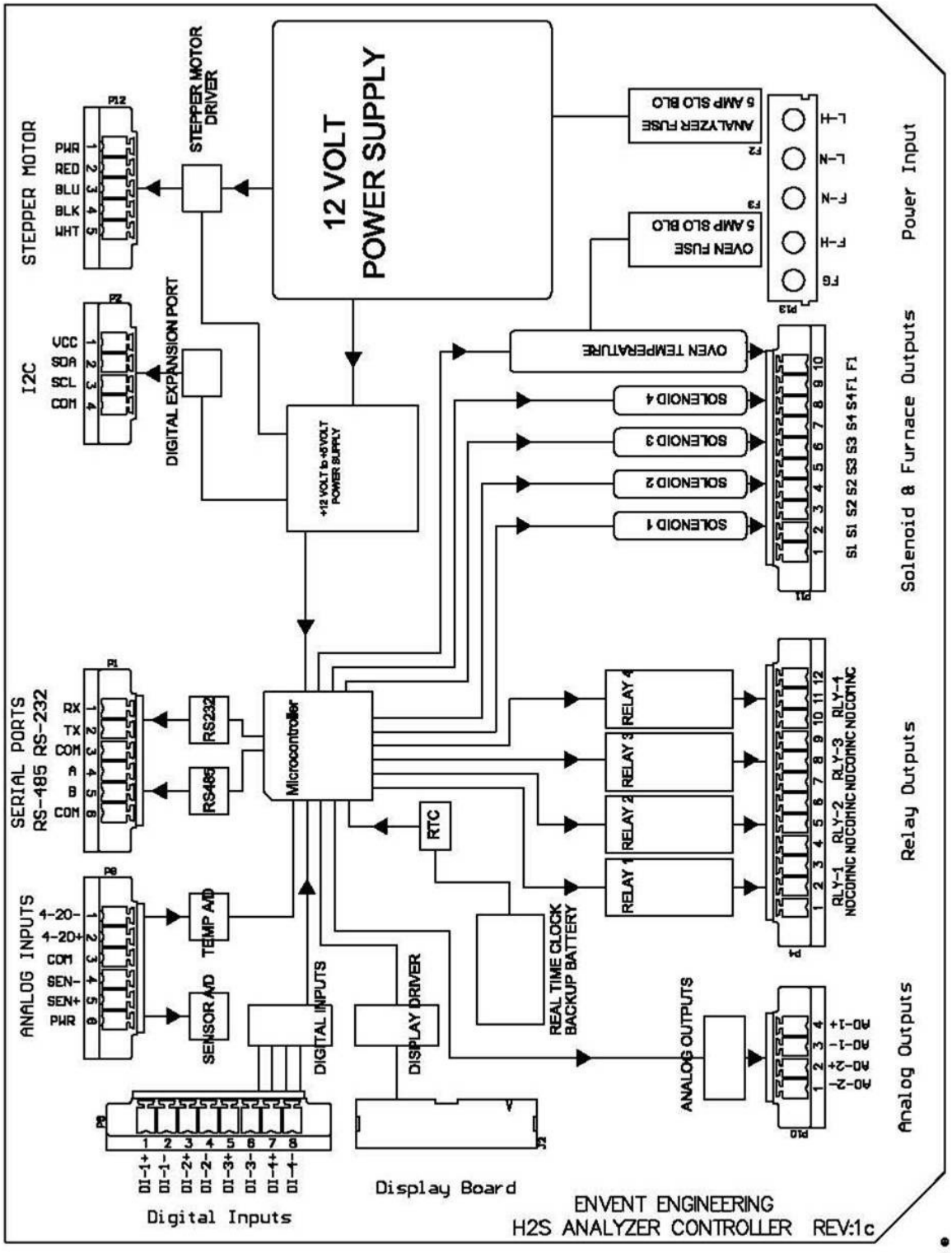


Figure 19: Controller board schematic

Chico A Sealing Compound

For Sealing Fittings in Hazardous Locations
Installation & Maintenance Information

INSTALLATION

DAM:

Using "Chico X" Fiber, make a dam in each conduit hub (except the one extending upward) so that the "Chico A" sealing compound, while fluid, cannot leak out of the sealing chamber.

Use the EYS-TOOL-KIT to pack a proper fiber dam **(do not use metal tools)**. Proceed as follows:

1. Force the conductors forward.
2. Pack fiber into each conduit hub behind the conductors.
3. Push the conductors backward and force them apart.
4. Pack fiber between and around the conductors in each conduit hub. It is important that the conductors be permanently separated from each other, so that the sealing compound will surround each conductor.
5. Pack fiber into each conduit hub in front of the conductors.

⚠CAUTION:
Do not leave shreds of fiber clinging to side walls of sealing chamber or to the conductors. Such shreds when imbedded in the compound may form leakage channels. The completed dam should be even with the conduit stop.

6. If the Condulet is of a type or size that has a separate work opening, this should be closed by its cover before pouring the seal.

COMPOUND:

Follow these instructions carefully:
Use a CLEAN mixing vessel for every batch. Particles of previous batches or dirt may spoil the seal. The recommended proportions are, by VOLUME– 2 parts of Chico A compound to 1 part of clean water. Do not mix more than can be poured in 15 minutes after water is added. Use cold water. Warm water increases speed of setting. Stir immediately and thoroughly.

⚠CAUTION:
If a batch has started to set, do not attempt to thin it by adding water or by stirring. Such a procedure may spoil the seal. Discard partially set material and make up fresh batch. After pouring, immediately close the pouring opening.

FOR APPLICATIONS INVOLVING GROUPS C AND D

⚠CAUTION:
Sealing compound to be mixed ONLY at temperatures above 35°F (2°C) and ONLY poured into fittings that have been brought to a temperature above 35°F (2°C). Seals must NOT be exposed to temperatures below 35°F (2°C) for at least 8 hours.

FOR GROUP B APPLICATIONS

⚠CAUTION:
Sealing compound to be mixed ONLY at temperatures above 40°F (4.4°C) and ONLY poured into fittings that have been brought to a temperature above 40°F (4.4°C). Seals must NOT be exposed to temperatures below 40°F (4.4°C) for at least 72 hours.

KEEP compound dry by having container cover tightly closed when not in use.
NOTE: For additional details see IF 287 packed with sealing fitting.

Figure 20: Chico A Sealing Compound

Optional Low Pressure Switch

When there is low or no gas pressure entering the analyzer, the pressure switch triggers the analyzer to alarm. The pressure switch has been set at the factory to 10psi on the descending side; therefore, the analyzer will go into alarm when the pressure of the gas decreases to 10psi or below. The figure shown below shows how the pressure switch is wired to the analyzer. *Please note that there is a fail-safe when connecting the normally open wire 'NO' rather than the normally closed wire 'NC' - the analyzer will also go into alarm if there is a problem with the wires (ex. one cut).*

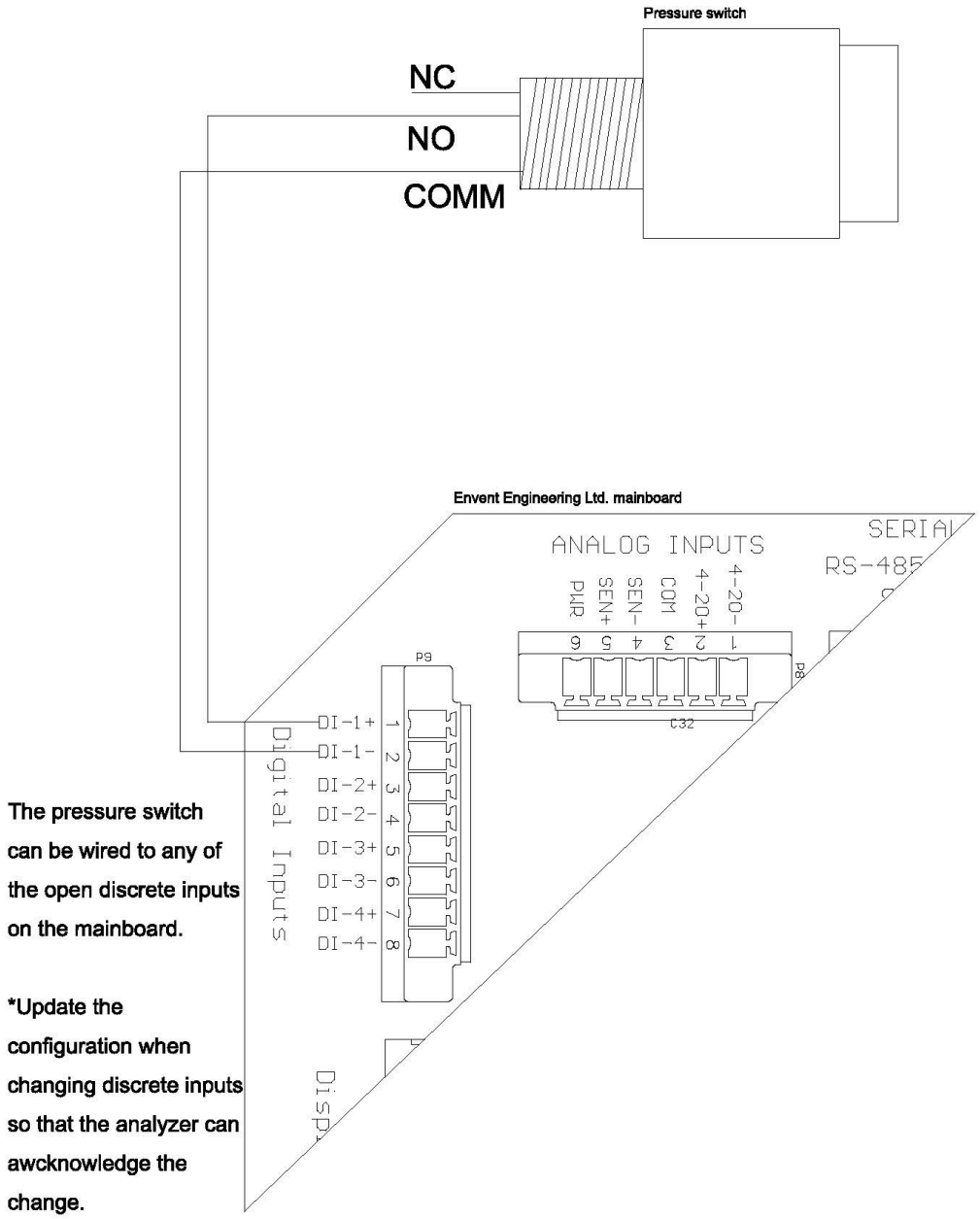


Figure 21: Optional Low Pressure Switch

This document has been continuously improved and revised over time; see the table below for revision (rev) information.

Rev No.	*Rev Date*	*Rev Description*
0	Nov 2011	Combined 330 & 3331 Operator's manual into one
1	Jan 2012	Edited sensing tape reaction formula and appendix drawings for clarity
2	Oct 2012	Added electrical rating for group B on 330
3	May 2014	Edited, formatted, changed drawings, calibration procedure

For further information, or a copy of our most recent operating manual, please visit us at www.envent-eng.com. Envent Engineering Ltd. reserves the right to change product design and specifications at any time without prior notice

Head Office

7060E Farrell Road SE
Calgary, AB T2H 0T2 Canada
T +1.403.253.4012
F +1.403.253.4016
CAN Toll Free 1.877.936.8368
info@envent-eng.com

USA Office

T +1.713.568.4421
USA Toll Free 1.877.936.8368
usasales@envent-eng.com

China Office

Beijing, China
T +86.138.0119.1148
chinasales@envent-eng.com